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The GOER Concept

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ABSTRACT

This paper has been written to further the designer's understanding of the military vehicle design parameters, as they exist today, of the modern day field army's need for a new family of vehicles, which will traverse all types of terrain rapidly and efficiently with an increasing variety of cargo and weapons. The walking army of the past is yielding to the mechanized army on wheels. Since the design of automotive vehicles is at best a compromise, the effectiveness of the completed design depends largely on the talent and finesse of the designer. The GOER concept is such an approach.

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UNDER THE THREAT of nuclear weapons, massed troops, groupings of artillery, the massed arrangements of tanks that characterized World War I and II operations and fixed facilities such as roads, bridges, and railroads, will give way to extremely mobile formations, dispersed over the widest area their firepower can defend. The units will be harder to communicate with logistically, and become more difficult to supply.

While air transport is regarded by some as the answer to the mobility problems, for the vast bulk of military material, main reliance still will be on surface transportation. Under these conditions the need for logistic vehicles with improved mobility is evident.

Experience and tests point up a number of design characteristics which contribute to wheeled vehicle ground mobility. Low pressure wide-base tires which contribute to low ground pressures and high flotation are important. Good wheel suspension or vehicle articulation, or both, are necessary to obtain maximum ground contact and traction. Positive, all-wheel drive is essential. High ground clearance (to traverse wet, marshy terrain), high angles of approach and departure, and low break angle are essential for negotiating obstacles. Of major importance is high horsepower-to-weight ratio, to provide the power needed to climb grades, maintain high road speeds, and traverse difficult terrain.

For military application, attention also must be given to other factors which contribute to maximum practicable mobility. All-weather operation in conditions ranging from -65 F arctic temperatures to +125 F of tropical climates. Operation over all types of soils and irregular terrain, fording of hard-bottom water crossings, and swimming in deep inland waters are needed to maintain the close support and dispersal of forces required by the modern field army. The Berne International Clearances for railroad transport and the limitations of air transport also must be considered.

Operation, maintenance, and support of the new vehicle families also require attention. Ruggedness and reliabilty, better than now provided in standard vehicles, should be incorporated into their design. Standardization of design should minimize the logistical burden of parts support and the problems of production of both vehicles and parts.

To meet these demands, the Army is undertaking the replacement of traditional weapons and logistical resupply equipment with new items specially developed for atomic warfare, but equally useful in any modern non-nuclear war.

ONE APPROACH - THE GOER

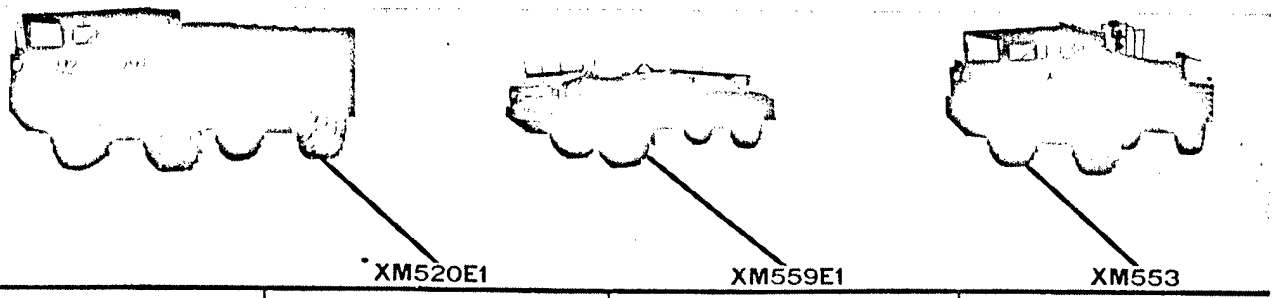
The term "GOER" is generic, and has informally been adopted to describe a type of military tactical wheeled vechicle, with a capability of carrying large tonnages, and offering agility, maneuverability, mobility, and flotability. The GOER, benefiting from designs offered by heavy earthmoving equipment, has exoskeletal construction, positive powered wagon steering, and large diameter, low pressure tires. It is primarily an off-road vehicle, offering effective mobility over adverse terrain, and on dry rocky soils, in mud, or on the water.

There are two families of GOER vehicles--the 8-ton (Fig. 1) and the 16-ton (Fig. 2). Each family comprises three types of vehicles--a cargo carrier, a fuel transporter and servicing vehicle, and a wrecker.

GOERs CONFIGURATIONS

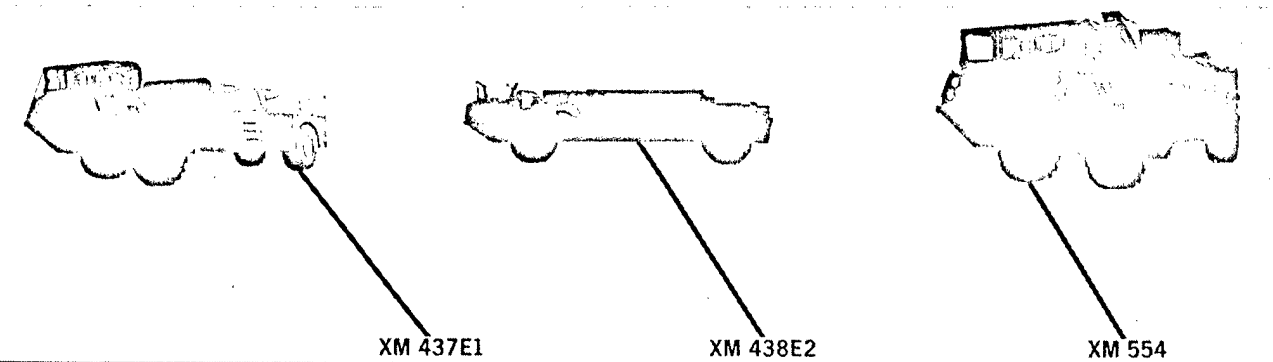
In both families, within their respective weight classes, the GOER front and rear units are interchangeable. The GOER front power unit can be used with the rear unit in cargo, tanker, and wrecker configurations. Other rear units can be of any configuration, that is, missile carrier, missile support equipment, command post, mobile power unit, field kitchen, repair shop, Army aircraft recovery vehicle, and many others (Figs. 3 and 4).

The GOER front and rear unit, however, were not designed for interchangeability like that of tractors and semi-trailers. But they can be interchanged by the facilities available in third echelon or higher maintenance shops and in supply depots. This permits matching of front power units



	XM520E1	XM559E1	XM553
CURB WEIGHT	24,665 lbs.	28,190 lbs.	38,750 lbs.
PAYLOAD	16,000 lbs.	2,500 gal. or 8 TONS OF FUEL	8,650 lbs.
HEIGHT (REDUCIBLE TO)	8 ft. 3 inches	8 ft. 10 inches	9 ft. 10 inches
LENGTH	35 ft. 3 inches	32 ft. 10 inches	33 ft. 2 inches
WIDTH	9 ft.	9 ft.	9 ft.
GROUND CLEARANCE	24 inches	24 inches	24 inches
ENGINE	CATERPILLAR D333 TA 6 CYL DIESEL 525 CUBIC IN. 213 BHP AT 2200 RPM	CATERPILLAR D333 TA 6 CYL DIESEL 525 CUBIC IN 213 BHP AT 2200 RPM	CATERPILLAR D333 TA 6 CYL DIESEL 525 CUBIC IN. 213 BHP AT 2200 RPM
TRANSMISSION	CATERPILLAR, POWER SHIFT W/TORQUE CONVERTER	CATERPILLAR, POWER SHIFT W/TORQUE CONVERTER	CATERPILLAR, POWER SHIFT W/TORQUE CONVERTER
STEERING	HYDRAULIC WITH MECHANICAL FOLLOW-UP	HYDRAULIC WITH MECHANICAL FOLLOW-UP	HYDRAULIC WITH MECHANICAL FOLLOW-UP
TIRE SIZE	18:00x33	18:00x33	18:00x33
SPECIAL CAPABILITIES		FUEL 3 VEHICLES AT ONCE	CAN LIFT AND TOW 10 TONS, HAS REAR MOUNTED 45,000 lbs. TOW WINCH, CARRIES TWO SPARE 18:00x33 TIRES

Fig. 1 - The 8 ton GOER family



	XM 437E1	XM 438E2	XM 554
CURB WEIGHT	38,670 lbs.	39,580 lbs.	57,600 lbs.
PAYLOAD	32,000 lbs.	5,000 gal. or 32,000 lbs. of FUEL	8,650-NORMALLY AN M60 TANK POWER PACK
HEIGHT (REDUCIBLE TO)	8 ft. 11 in.	9 ft. 6 in.	9 ft. 11 in.
LENGTH	40 ft. 11 in.	38 ft. 2 in.	41 ft. 6 in.
WIDTH	10 ft. 3 in.	10 ft. 3 in.	10 ft. 3 in.
GROUND CLEARANCE	30.5 inches (loaded)	30 inches	30 inches
ENGINE	GMC, 567.5 cu. in. 8V71 LIQUID COOLED DIESEL 336 BHP AT 2300 RPM	GMC, 567.5 cu. in. 8V71 LIQUID COOLED DIESEL 336 BHP AT 2300 RPM	GMC, 567.5 cu. in. 8V71 LIQUID COOLED DIESEL 336 BHP AT 2300 RPM
TRANSMISSION	FULLER CONSTANT MESH AIR ACTUATED-MECHANICAL 5 SPEED W/2 SPEED SPLITTER-ONE REVERSE	FULLER CONSTANT MESH AIR ACTUATED-MECHANICAL 5 SPEED W/2 SPEED SPLITTER-ONE REVERSE	FULLER CONSTANT MESH AIR ACTUATED-MECHANICAL 5 SPEED W/2 SPEED SPLITTER-ONE REVERSE
TIRE SIZE	29.5 X 25.00	29.5 X 25.00	29.5 X 25.00
STEERING	POSITIVE ELECTRIC WAGON STEER 90°	POSITIVE ELECTRIC WAGON STEER 90°	POSITIVE ELECTRIC WAGON STEER 90°
SPECIAL CAPABILITIES		FUEL 5 VEHICLES AT ONCE	CAN LIFT/TOW 20 TONS HAS REAR MOUNTED 30 TON TOW WINCH CARRIES TWO SPARE 29.5 X 25.00 TIRES

Fig. 2 - The 16 ton GOER family

with the number or kind of rear units needed for any particular situation. It also permits replacing of a unit which may be disabled by enemy action or by mechanical breakdown.

GOERs BASIC DESIGN

Exoskeletal design of the GOERs eliminates frame, subframe, springs, and shock absorbers. This provides strength, light weight, and rigidity to the body; and provides suitable load carrying characteristics which are inherent in a monocoque body.

Lateral articulation between front and rear units is 20 deg on each side, providing adequate oscillation for the roughest terrain without undue strain or damage. This feature enables GOERs to cross gullies and ditches and other obstacles without the body rack which solid-frame vehicles experience (Fig. 5). It also provides four-wheel ground contact, to maintain control and maximum traction at all times.

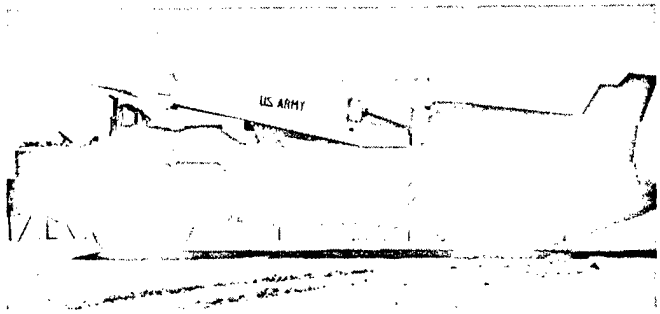


Fig. 3 - Test bed, Nike-Hercules transporter (GOER), erector, launcher

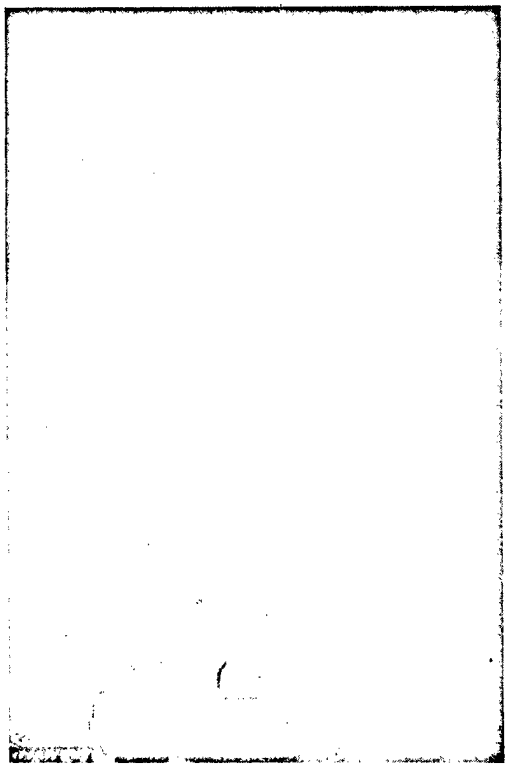


Fig. 4 - Missile launch from test bed, Nike-Hercules transporter (GOER) erector, launcher

The smooth, clean underside of the GOERs, plus high ground clearance, also facilitate the negotiating of ditches and banks, rocks, outcroppings, and other obstacles.

Utilizing large diameter, low pressure tires, the GOERs suspension has no springs, thus permitting reduced maintenance requirements; the loads are transmitted directly to the frame through the axles. Tests conducted at Aberdeen Proving Ground concluded that the GOER approach was suitable for transporting missile systems, and that the maximum response measured even under the worst conditions tested, was equal to the best of standard comparative vechles now utilized for such use. There are few parts as compared to a typical truck-type multi-axle suspension system.

The "big wheel" suspension principal helps to provide the high ground clearance, and with the smooth, clean underside enables the GOER to travel where other units will "bottom out" and stall. The wide, low pressure tires give good traction and flotation in adverse conditions. They also absorb road shocks, permitting higher optimum speeds for both on and off-the-road.

The large diameter GOER tires permit high axle loading while, at the same time, they keep ground pressure low. It is the unit ground pressure rather than the total axle loading that is the critical problem in flotation. For a given tire, ground pressure also is a function of inflation pressure. Reduction of tire pressures--a common practive on many types of vehicles where poor underfoot conditions are encountered --is a capability provided for in the GOER, which has a central tire inflation/deflation system incorporated into its design. At the discretion of the operator, he can increase or decrease the tire inflation pressure from the operator's position. Gages are provided for front and rear tires for direct readings and, by use of the same control, he can inflate or deflate the tire pressures, even while the vehicle is moving.

In Alaskan tests, a GOER unit succsssfully proved its mo-

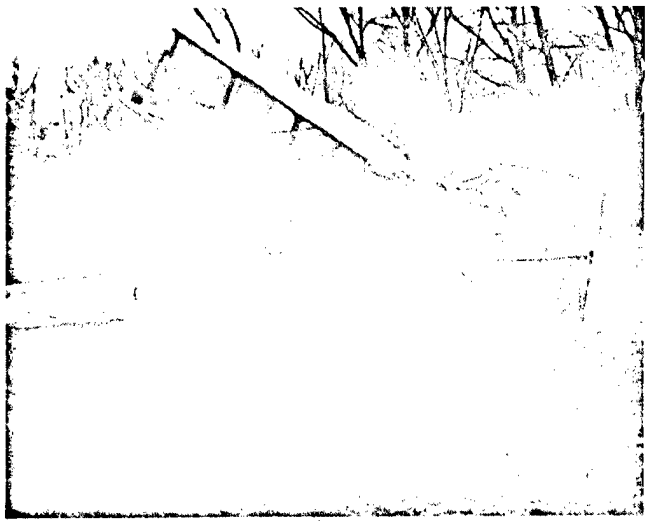


Fig. 5 - Cargo truck: 8 ton, 4 x 4, XM520E1, traversing 6 ft ditch with full payload

bility capabilities in snow up to 60 in. deep. Mud in excess of 40 in. has also been successfully negotiated (Figs. 6A and 6B).

The GOER all-purpose tire was designed for the military to be a compromise between long life at road speeds and cross-country tractive ability. Because all-around mobility includes cross-country and road travel, neither high traction tires nor the ideal road tires accomplish the purpose. Development of improved tires for both types of operations in a single tire is still continuing.

GOERs have positive powered wagon, or articulated steering. Units with this type of steering increase the mobility of a vehicle because it allows the unit to be "duck walked" or swung from side to side through soft or wet underfooting. Each swing draws the trailing unit forward by a 2 - 1 mechanical advantage, and is continued until the unit has passed over the soft ground to firm ground. The wagon steering also affords better maneuverability when swimming. Tests have shown that the GOER can turn in a circle, little or no greater than the turning circle on land.

THE 8-TON SERIES

Power Train - From the engine, the power is carried through the transmission to a drop gear box and short propeller shaft, to the front differential, and out to the planetary drives in the front wheels. Power to the rear wheels is carried from the front differential through a disconnect clutch, then through propeller shafts and universals to the rear differential. The final drives in the rear wheels are also planetary (Fig. 7).

The differentials are identical torque-proportioning units, which split the torque between the wheels as required. This prevents the loss of engine power and traction from slippage of a single wheel.

The rear wheel drive can be utilized in first and second gears to provide 4 x 4 operation at speeds up to 10 mph. The rear wheels are automatically disconnected on the shift from second to third gear. A manual override is provided so that the operator can engage the rear wheels at speeds above 10 and up to 30 mph, as the need arises. This feature is of primary importance to provide the highest possible speeds of 3-4 mph when swimming in inland waters, and is useful under certain road conditions. Air brakes for all four wheels are provided, and incorporate a fail-safe feature. Loss of air for any reason will automatically apply the brakes and bring the vehicle to a stop.

Engine - The Caterpillar liquid cooled D333 compression ignition engine powers the 8-ton series of vehicles. The engine is turbocharged and aftercooled. Although capable of delivering up to 300 flywheel horsepower, in this application it is set at 213 maximum brake horsepower at 2200 rpm. Starting is accomplished through a 24 v direct electric starting system, with an electric glow plug in each cylinder. This starting system has been found satisfactory in Alaskan tests where the engine was started, using the glow plugs only, after cold-soaking in temperatures as low as -38 F. The D333 GOER engine burns CIE fuel, Nos. 1 and 2 diesel fuel, No. 2 furnace oil, and JP 4 and 5 jet fuels. With modifications it can be adapted for other fuels such as gasoline and crude oil.

Transmission - The 8-ton GOER is equipped with a Caterpillar 6-speed planetary-torque converter power-shift transmission. It provides a combination of torque-converter and direct drive in the first two gear ranges and reverse where high torque requirements are important. The torque split

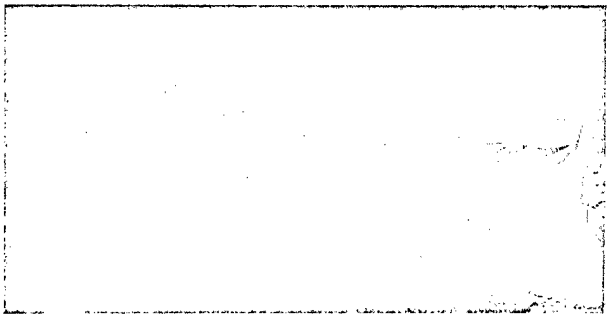


Fig. 6B - Cargo truck: 8 ton, 4 x 4, XM520E1, traversing mud cross-country course with payload

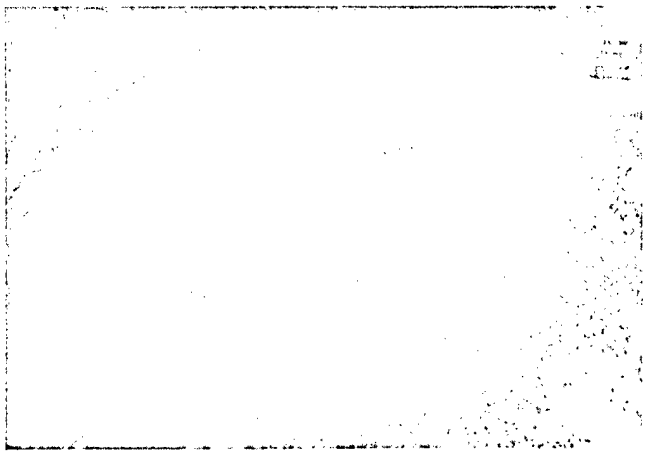


Fig. 6A - Cargo truck: 16 ton, 4 x 4, XM437E1, towing 155mm Howitzer through 40 in. deep mud with full payload

Fig. 7 - 8 ton GOER family power train

of 62-1/2% through the converter and 37-1/2% direct drive combines the solid feel and economy of direct drive with the torque multiplication of the converter. The final four gear ranges are direct planetary drive for high efficiency in highway travel.

All six forward speeds and the one reverse speed are controlled by a single shifting lever at the operator's right hand. Shifting is accomplished in a fraction of a second, and is hydraulically actuated and modulated for smooth performance.

Steering - The 8-ton GOER has positive-powered wagon-steering by means of two double-acting hydraulic cylinders. Turning the steering wheel actuates a hydraulic valve which is connected to a follow-up linkage, providing the operator both ease of operation and a natural steering feel. With 60 deg of steering capability right and left of the longitudinal axis, maneuverability is better than with automotive-type steering (Fig. 8).

Turning radius, for example, is 25 ft, compared to 41 ft, 3 in. for the standard 5-ton 6 x 6 truck.

THE 16-TON SERIES

Power Train - Directly coupled to the rear of the engine, is a a-c generator, the main auxiliary power for the 16-ton GOERs. This is directly connected by a heavy duty disconnect clutch to a coupling shaft connected by a crossover gear box to the transmission assembly, then to ring gears and a torque-proportioning differential, and out to the planetary drives in the front wheels. Power to the rear wheels is provided by the main generator to independent electric motors for each rear wheel gear box. These drive through to coupling shafts which carry the power to planetary gears in the rear wheel hubs. Water propulsion is provided by the two front wheels only which, for this vehicle, proved more effective than all wheel drive in the water. Water speed is 3.5 - 4.3 mph. Sealed, disc-type air brakes are used in these GOERs, and incorporate a fail-safe feature (Fig. 9).

Fig. 8 - Cargo truck: 8 ton, 4 x 4, XM520E1, top view with cargo body doors fully open and vehicle at full 60 deg left steer attitude

The LeTourneau-Westinghouse torque proportioning differential, used in the 16-ton GOER, the same as utilized in the 8-ton GOER, provides the means of slowing the inner wheel and speeding up the outer one when the vehicle is turning. At the same time it proportions power between the wheel with poor traction and the one with greater traction, sending more power to the wheel which is driving, and reducing power to the slipping wheel.

The rear wheels, on the trailing units, are powered to provide traction, in addition to the front wheel drive, for heavy mud, deep sand, under heavy loads, or in steep climbs. The rear drive operates when the transmission is in 1st, 2nd, or 3rd forward gears or reverse gear, up to 10 mph. The drive is always operating in 1st and reverse gear. An override switch can be turned on for automatic operation in 2nd or 3rd gear.

Air brakes are provided for all four wheels. Loss of air for any reason will automatically apply the brakes, and bring the vehicle to a stop. An electrotarder is placed in the main generator circuit to place a load on the generator to provide dynamic braking for down grades, thereby reducing maintenance on the wheel brakes to a minimum.

Engine - The engine is a General Motors, Detroit Diesel Div., Model 7083-7200, V-type, 8-cyl, 2-cycle, diesel engine. The engine has a compression ratio of 17:1 and a total displacement of 567.5 cu in., developing a maximum gross horsepower of 336 at 2300 rpm. Starting is accomplished through a 24 v direct electric starting system. Cold weather starting down to -25F is incorporated in the engine, and consists mainly of a heater placed in the engine air intake. The heater raises the temperature of the incoming cold air sufficiently to enable the heat of compression temperature to fire the air-fuel mixture. The engine burns CIE fuel, Nos. 1 and 2 diesel fuel, No. 2 furnace oil, and JP 4 and 5 jet fuels. With modification it can be adapted for other fuels such as gasoline and crude oil.

Generator - The LeTourneau-Westinghouse standard 3-phase generator rotor is directly coupled to the engine fly-

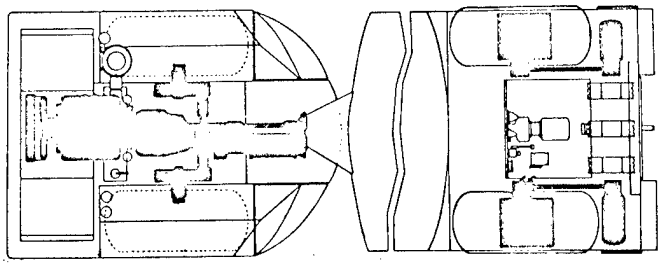


Fig. 9 - 16 ton GOER family power train

wheel. It is a 10-pole, lightweight generator, rated at 479 v, 192 cycles at 2300 rpm, with only low excitation voltage passing through the slip rings. The power generated is proportionately used for operation of the full power steering, rear wheel drive, main fuel pump drive (tanker), crane drive (wrecker), and other auxiliary power needs.

Transmission - The transmission is a Fuller commercially available air actuated sliding five-speed gear-type and two-speed transfer-case and is provided with seven speeds forward, neutral position, and one speed in reverse. The transmission shift lever is located to the right of the operator's seat. Gears are selected manually and are shifted in and out of engagement by an air-controlled assembly mounted on the top of the transmission. The two-speed transfer box, coupled to the transmission, is controlled by an air-operated splitter-mechanism, which automatically selects the high or low range of the transfer-case gears required to produce the gear selected by positioning of the shift lever. The seven forward gears are a combination of the five gears in the transmission in conjunction with the two ranges in the transfer-case.

Rear Assist Drive - The rear wheels on the trail units are powered to provide traction and power, in addition to the front wheel drive, for heavy mud, deep sand, under heavy loads, or in steep climbs. The rear drives consist of a three speed auxiliary rear-wheel drive. A two-speed explosion proofed LeTourneau-Westinghouse a-c motor (power supplied by the main generator) is coupled to a two-speed gear box. High speed of the a-c motor and low speed of the gear box provide a speed matched to front wheel drive in first gear of the transmission, low speed of the a-c motor and high speed of the gear box provide a matched speed equal to second speed of the front wheels, and high speed of the a-c motor and high speed of the gear box matches the third speed of the front wheels.

From the gear boxes, coupling-shafts carry power to planetary gears in the rear wheel-hubs, driving the wheels. The motors are controlled by a switch located on the instrument panel. The drives will operate only when the transmission is in 1st, 2nd, or 3rd forward gear or reverse gear, and provides speed in four-wheel drive up to 10 mph. The drives are always operating in 1st and reverse gear. If the switch is actuated to the ON position, the drives will automatically actuate when the transmission is placed in 2nd or 3rd gear. To prevent damage to the vehicle under certain operating conditions, the rear drives are also controlled by a limit switch located in the king-pin housing. The limit-switch will cut off current flow to the rear-drive motors when the prime mover is turned to an angle of 30 deg in relation to the trailing unit. The rear-drive unit-switches can be bypassed by holding rear-drive override switch limit to the ON position. This provides additional power when the truck is turning beyond the 30 deg limit imposed by the limit switch, and the rear drives are needed to maintain momentum during the turn, such as the "duckwalking" operation.

Steering - The 16-ton GOER steering is a LeTourneau-Westinghouse wagon-type electric positive-power system. The system consists of a constant running electric motor; two planetary clutches enclosed in a housing; a shaft connecting the clutch housing to the steering gear box; the gear box driving a pinion; and the pinion engaging a ring gear to turn the prime mover. A steering wheel and control cable connect to the clutch cam, actuating the planetary steering clutches. Degree of band engagement determines speed of turn, and force applied provides the torque necessary to turn the prime mover 90 deg, right and left, relative to the trailed unit (Fig. 10). This is a 100% power steering system, control of course at the operator's discretion. This system also provides the ability to "duckwalk". The torque proportioning differentials are also an influencing factor in accomplishing this "walking" action.

Brakes - In addition to the sealed disc-type air brakes on all four wheels, a simple resistance grid to load the main a-c generator controlled by the operator by an ON-OFF type switch is provided as an effective braking device for long down grade operations. On such operations, this feature reduces maintenance of the primary wheel brakes to a minimum. When going downhill, or when engine tends to overspeed, a switch connected by a cable to an adapter shaft, automatically activates the electrotarder to place a load on the generator circuit and slow the engine revolutions to the set governor speed.

GOER CONFIGURATIONS

8-TON FAMILY

Front Power Unit - The power unit consists of a lightweight, rigid, unitized body and frame, separated into driver and crew compartment, engine compartment, and transmission, differential, and final drive compartment. This construction also provides an all-welded steel, watertight

Fig. 10 - Cargo truck: 16 ton, 4 x 4, XM437E1, top view of tractor at 90 deg steer

compartment. All of the operating mechanisms are fully enclosed, with exception of the wheels and steering mechanism. A front mounted winch of 10,000 lb capacity, hydraulically driven, is provided for vehicle assist purposes. The power unit is used with the rear unit in all cargo, tanker, and wrecker configurations.

8-Ton Cargo Truck - This basic GOER is a vehicle designed to give maximum mobility to eight tons of cargo. The cargo body is a lightweight, high-strength design with the loads carried through the floor structure. In effect, the entire subfloor structure is a shallow, triangular fabricated beam. The floor is of 2 in. corrugated sandwich construction; the sides are corrugated panels. High-tensile steel is used to reduce weight and keep cost at a minimum (Fig. 11).

The eight ton payload capacity is based on a cargo density of 27-1/2 lb/cu ft. The floor of the cargo body will accommodate six standard military loaded pallets (each pallet being 44 x 52 x 54 in. high), or one Conex container (8 ft 6 in. x 6 ft 3 in. x 6 ft 10 in. high) and two pallets, or up to twenty-five 55 gal drums standing on end.

The two side doors and rear door are interchangeable and large enough for loading of the pallets from either side, or the rear. Conex containers are loaded overhead. When closed, the doors are watertight.

Bows and tarpaulin are provided to protect the cargo, or troops when carried, from the elements.

The approximate curb weight of 24,850 lb of the GOER cargo vehicle gives a favorable payload to weight ratio. This vehicle is air transportable.

2500 Gal Tanker - The basic chassis features of the rear tanker unit are the same as for the cargo unit. The tank is of all-welded steel construction designed to haul 2500 gal of fuel. The tank unit is equipped with a pump, piping, valves, and hoses for self-loading with fuel, and for delivering fuel to other vehicles or to storage tanks. The equipment is mounted in a large compartment at the rear of the tank. A rear cover and two side covers on the compartment provide accessibility to three hose reels from the ground. The interior of the tank has a series of baffles, so arranged as to prevent any appreciable movement of fuel in the tank from affecting the balance of the vehicle, during side slope or water operations.

The three discharge hoses provided are one of 100 gpm capacity and two with 50 gpm capacity each. Another outlet is provided for a maximum discharge rate of 300 gpm. With these rapid discharge rates and multiple outlets, transfer of fuel can be accomplished in minimum time. A highly efficient filtering system keeps the delivered fuel clean, including the removal of any trace of water. Space is provided for two 55 gal barrels of lubricating oils. Like the cargo vehicle, this unit will have cross-country and swimming mobility, and is air transportable (Fig. 12).

10-Ton Wrecker - Similar to the 2500 gal tanker, the 10-ton wrecker chassis features are basically the same as for the 8-ton cargo unit. The vehicle has been modified and equipped with a crane, outriggers, davit, rear winch, and other equipment for use as a wrecker. Sufficient cargo area in the trailing unit bed has been provided to carry the largest combination of powerplant, engine-transmission assemblies for combat vehicles (that is, tanks, self-propelled artillery, and the like) for replacement under field conditions. Normal equipment includes a full complement of repair tools for field maintenance activities.

The hydraulically operated crane of 10 ton capacity is installed in the front of the trailing unit. The crane is cantilever-mounted from a vertical pintle and is capable of continuous rotation in the horizontal plane. Automatic controls are provided to prevent the crane from swinging over the front of the vehicle when the boom is too low for clearance. A single-acting hydraulic cylinder provides positive boom extension and retraction of 3 ft. Hydraulic motors driving through planetary-transmissions are used to operate the hoist-drum and to swing the crane. The crane is protected from overloading by an automatic valve located in the boom-hoist cylinder.

The outriggers are an integral part of the body structure and are used to support the vehicle when the crane is in operation.

Each outrigger is raised to the stowed position, or lowered to the supporting position, by means of a manually operated

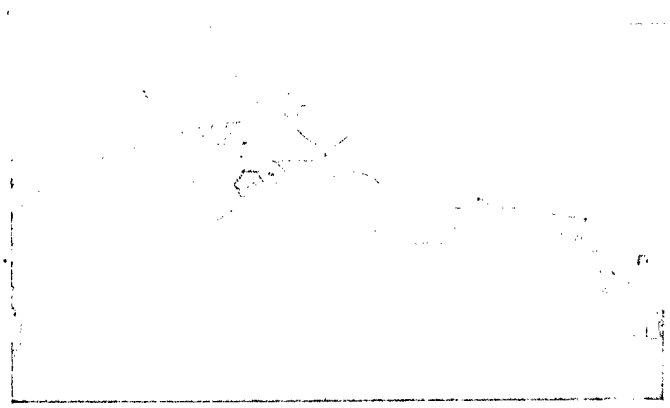


Fig. 11 - Cargo truck: 8 ton, 4 x 4, XM520E1, loading for shipment to Alaska in C124 aircraft

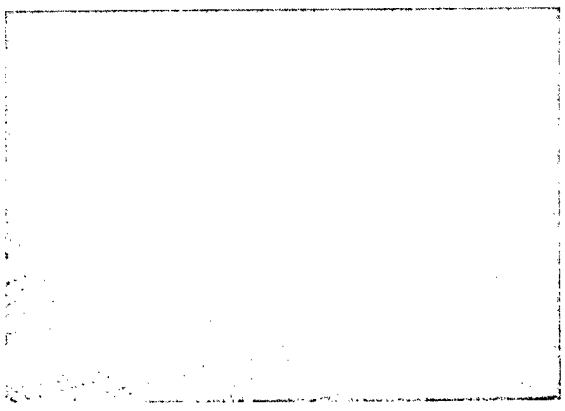


Fig. 12 - Tank truck: Fuel servicing, 2500 gal, 4 x 4, XM-559E1, climbing 30% slope fully loaded

crank. The crank is also used to lock the outrigger in any desired position.

The manually operated davit, of 1000 lb capacity, can be rotated through a complete circle and locks in any position. Positive extension and retraction of the boom are provided, and a chain hoist is attached to the boom for the raising and lowering of a load. A mounting socket, for the davit, is provided on each side of the body, behind the side door.

A 45,000 lb capacity winch is mounted at the rear of the trailing unit. The winch is powered by a hydraulic motor driving through a two-speed planetary transmission. A door is provided in the rear of the body for access to the winch and cable.

The wrecker also will have optimum land and water mobility and is air transportable (Fig. 13).

16-TON FAMILY

Front Power Unit - The power unit is an all-welded lightweight steel hull separated into driver and crewman compartments; winch compartment; engine compartment; differential and final drive compartment; and transmission compartment, with external mountings for air cleaner; lubrication and fuel filters; and fuel tanks. All of the operating mechanisms are fully enclosed by the hull with the exception of the wheels and axles, which are sealed to make them watertight. A front-mounted winch of 20,000 lb capacity, electric motor driven is provided for assist purposes. The power unit is used with the rear unit in the cargo, tanker, and wrecker configurations.

16-Ton Cargo Truck - This basic vehicle of the 16-ton family is designed to provide the maximum mobility on land and water, and is air transportable. The cargo body is a lightweight, large flat-bed body, enclosed on all four sides by welded frames and an outer skin corrugated for strength, and sealed against water entry. The floor space will accommodate 10 standard military pallets, or two Conex containers and two pallets. When converted to a troop carrier, with the side boards converted to seats, the vehicle can carry up to 44 combat equipped soldiers. The two side doors are interchangeable; however, pallet loading through these doors are restricted unless the height of the pallets are less than 45 in., such as ammunition pallets. Unrestricted loading can be accomplished through the rear door. Conex containers are loaded from overhead. When closed, the doors are watertight. Bows and tarpaulin are provided to protect the cargo, or troops when carried, from the elements (Fig. 14).

5000-Gallon Tanker - The GOER used as a 5000 gal tanker provides mobile service-station facilities for vehicles and aircraft in remote areas. The tank is of all-welded steel construction. The interior of the tank has a series of baffles arranged to prevent any appreciable movement of the fuel in the tank from affecting the balance of the vehicle, during side slope or water operation, and from surge-type loads. The tanker unit is equipped with a pump, piping, valves, and hoses for self-loading and delivery to other vehicles, or to storage tanks. The equipment is mounted in a large compartment at the rear of the trailing unit. A rear cover and two side covers on the compartment provide accessibility to five hose reels from the ground.

The five discharge hoses provide 60 gpm capacity each, simultaneously. Another outlet is provided for a maximum discharge rate of 300 gpm. Pressure for the fueling or defueling operations is provided by an explosion-proof electric motor driving a pump installed in the control compartment. The system is capable of bottom loading of the tank.

A highly efficient filtering system keeps fuel clean, and removes all traces of water and other contaminates from the delivered fuel. This vehicle also carries four 55 gal barrels of lubricating oil, five 5 lb cans of grease, and five 5 gal cans of other lubricating oils. Its mobility means fewer "service depots" for the combat arms. Like all GOERs, this vehicle can "swim" across rivers and inland lakes fully loaded, and is air transportable (Figs. 15A and 15B).

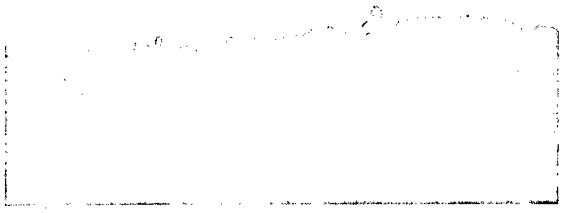


Fig. 14 - Cargo truck: 16 ton, 4 x 4, XM437E1 vehicle swimming with 16 ton payload

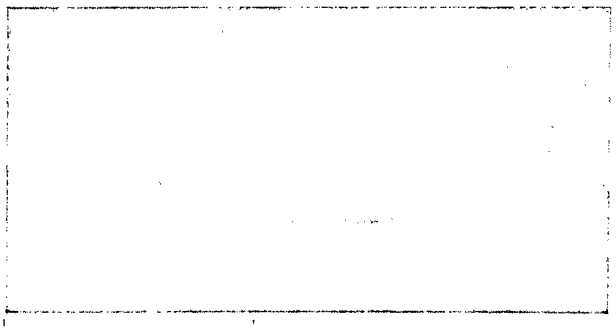


Fig. 13 - Wrecker truck: 10 ton, 4 x 4, XM553, swimming in inland waterway fully loaded

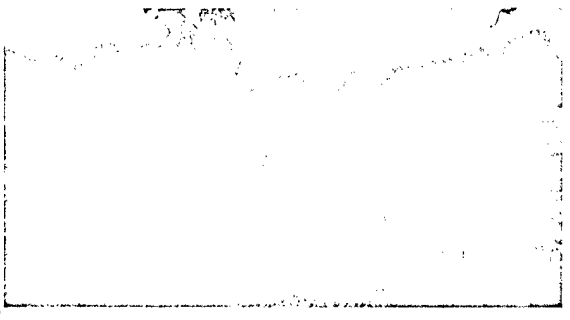


Fig. 15A - Tank truck: Fuel servicing, 500 gal, 4 x 4, XM-438E2, service station refueling of five M41 tanks

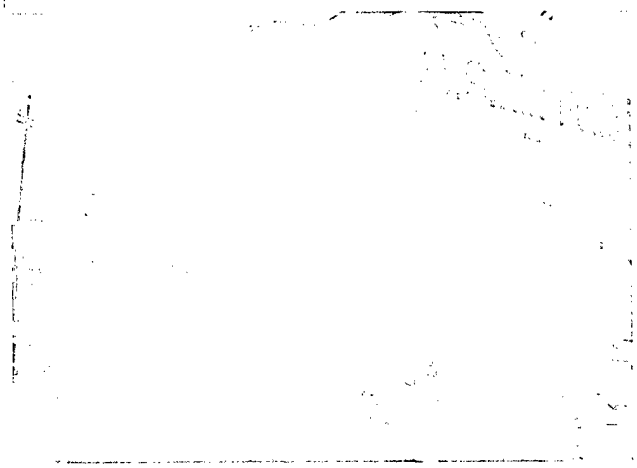


Fig. 15B - Tank truck: Fuel servicing, 5000 gal, 4 × 4, XM-438E2, loading aboard C124A aircraft

20-Ton Wrecker - Similarly, the 20 ton wrecker vehicle is a high mobility vehicle for use over all types of roads and terrain, as well as for fording or "swimming" in inland waterways. The wrecker is to serve as a mobile organizational and field maintenance facility for use by maintenance contact teams and maintenance crews operating at maintenance-support points.

The trailing unit is a lightweight, high-strength, large flat bed body, enclosed on all four sides. Hinged personnel access doors are located on each side of the body. A hinged door at the rear permits access to the rear mounted 60,000 lb capacity winch. Two wells, built into the sides of the trail unit, holds spare large diameter tires for the GOERs. Access to the tires is through large hinged doors in the sides. The doors are equipped with latches and seals to prevent entrance of water during "swimming" operations.

The crane is electrically operated and is capable of 360 deg of continuous travel. Three motors drive the three crane motions--boom hoist, load hoist, and swing. Main components of the crane consist of the following: a two-section boom, pinned together to form a rigid 20 ft long boom; a folding-frame which supports the boom-hoist and load-hoist mechanisms. Pins connect the frame to the revolving base, and can be folded down to meet Berne shipping dimensions. The boom-hoist mechanism is mounted on the rear of the folding-frame and helps to act as a counterweight for the boom, and consists of a reversible electric motor, speed reducing gear-assembly, and a wire-rope drum.

The load-hoist drum, motor, and gear-assembly are also on the folding-frame, forward of the boom hoist mechanism. The swing-mechanism is mounted below and in front of the revolving base. An electric motor and gear-assembly, through a chain and sprockets, drive the gear-assembly shaft. Extending from the gear-assembly housing is a pinion mounted on a vertical shaft. The pinion engages the revolving base ring-gear.

Fig. 16 - Wrecker truck: 20 ton, 4 × 4, XM554, swimming in inland waterway fully loaded

A limit-switch in the boom point assembly prevents overloading and will cut off power to the hoist-motor, if load limit is exceeded. This vehicle like all GOERs is air transportable (Fig. 16).

CONCLUSION

The development of these vehicles dates back to 1956, when the Armor Board at Ft. Knox, Ky., became interested in the mobility of the large tired earthmoving and construction equipment. Studies and demonstrations of commercial vehicles of this type, which were presented by the Armor Board, ultimately led to the development program for the military GOER vehicles.

In 1958 contracts were awarded to the Clark Equipment Co. for a 5-ton test vehicle, and to LeTourneau-Westinghouse Co. for 15-ton test vehicles. Tests of these vehicles were then conducted by various test agencies to evaluate the value of the GOER concept in military applications. The results of these tests were favorable, and formal military characteristics were prepared by the using services. These established the requirement for the 8-ton and 16-ton GOERs. In 1960 the initial contracts were awarded to the Caterpillar Co. and LeTourneau-Westinghouse Co., respectively, for development of the prototype vehicles.

Engineering and service tests of these vehicles were initiated in 1961, and extended through 1964. During this period, in 1962, decision was made by the Army to conduct Troop Tests with a larger number of the GOER vehicles. These Troop Tests, scheduled for the last half of 1964, will permit more definitive resolution of vehicle performance under conditions representative of planned usage, and provide a basis for selection and application to organizational elements of the Army.